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(71) Applicant: **Akzo Nobel N.V.**
NL-6824 BM Arnhem (NL)

(72) Inventors:
- **de Haan, Pieter**
  NL-5343 XB Oss (NL)
- **Poels-Janssen, Henrika Gerardina Maria**
  NL-5346 VY Oss (NL)

(74) Representative: **Beetz, Tom et al**
N.V. Organon,
Postbus 20
NL-5340 BH Oss (NL)

(54) Solid pharmaceutical composition comprising an excipient capable of binding water

(57) The invention concerns a solid pharmaceutical composition comprising less than 7% by weight of an oil or oily substance, a low dosage active ingredient, and a water insoluble non-cross-linked polymeric excipient capable of binding water and having a mean particle size greater than 150 µm. The composition can be obtained by a simple procedure comprising mixing the water insoluble non-cross-linked polymeric excipient capable of binding water and the active ingredient, which is dissolved or dispersed in an oil or an oily substance, in an aqueous dispersion thereof, or in water.

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Description

The present invention concerns solid pharmaceutical compositions comprising a water insoluble non-cross-linked polymeric excipient capable of binding water and less than 7% by weight of an oil or oily substance, and a process for the preparation of said solid composition.

Many solid pharmaceutical compositions are known in the art, see for instance the standard reference work of Gennaro et al., Remington's Pharmaceutical Sciences, (18th ed., Mack Publishing Company, 1990, see especially Part 8, chapter 89: Pharmaceutical Preparations and Their Manufacture). Usually tablets or capsules are prepared from granules comprising the active ingredients and additives or excipients. These excipients include diluents, binders, glidants, lubricants, and the like. General methods of tablet preparation are the wet-granulation method, the dry-granulation method, and the direct compression method. Each of these methods has its disadvantages, especially when low dosage active ingredients are formulated. For instance, in the wet-granulation method the active ingredient is usually dissolved or dispersed in a liquid, which is frequently an organic solvent causing environmental problems. In the dry-granulation method it is extremely difficult to get acceptable content uniformity when low dosage active ingredients are used. Direct compression methods are not generally applicable, since only ingredients having all the physical requirements for the formation of a good tablet can be used, especially possessing good cohesive and flow properties. Only very few ingredients have these required properties.

Since it is of considerable advantage to increase the efficiency of tabletting operations and reduce costs by using the smallest amount of floor space and labour as possible, there is a need for a very simple method of preparing drug loaded carrier particles for use in tablets and capsules. Moreover, if low dosage active ingredients are compressed into tablets problems concerning the content uniformity can occur. Existing methods for preparing tablets with low dosage active ingredients suffer from complexity, environmental problems, or poor reproducibility. An improvement was disclosed by Vervaet et al. (Int. J. Pharmaceutics 108 (1994) 207-212), who prepared pellets from micro-crystalline cellulose Avicel PH-101 and PEG-40 hydrogenated castor oil. These compositions contain 7-21% of hydrogenated castor oil and relatively small particle sized microcrystalline cellulose, and should be granulated, extruded and spheronised to obtain the pellets. Compositions comprising Avicel PH-101 were also disclosed in the intermediate PCT patent application WO 94/23700. Other methods requiring granulation are disclosed by I. Ullah et al. (Pharmaceutical Technology, September 1987, 48-54) and C-M. Chen et al. (Drug Development and Industrial Pharmacy, 16 (3), 1990, 379-394). According to these methods a moisture-activated dry granulation method was obtained by blending a drug with a dry binder, such as microcrystalline cellulose which is capable of absorbing remaining free moisture. Pharmaceutical compositions including water-swellable, but water-insoluble cross-linked polymers together with an oil, are disclosed in EP 598,337. Such compositions, however, have inadequate flow properties.

The present invention offers a solution for obtaining drug loaded carrier particles without the need of a granulation step by using a solid pharmaceutical composition comprising less than 7% by weight of an oil or oily substance, a low dosage active ingredient, and a water insoluble non-cross-linked polymeric excipient capable of binding water and having a mean particle size greater than 150 µm.

Water insoluble non-cross-linked polymeric excipients capable of binding water are diluents added to dosage units to increase the mixture and the resulting dosage units bulk. The preferred diluent in this invention is a carrier material with water uptake properties for incorporation of emulsions or oily liquids comprising a solution or dispersion of a low dose active agent. The preferred carrier materials are water insoluble cellulose or starch, like amorphous and microcrystalline cellulose or agglomerated starch, or mixtures thereof. The carrier material has a mean particle size greater than 150 µm (micrometer), and preferably at least 180 µm. The carrier material will typically make up from 20 to 99% by weight of the resulting pharmaceutical composition, which may contain apart from the carrier material capable of binding water any suitable pharmaceutically acceptable auxiliary. Auxiliaries include fillers, diluents, disintegrants, binders, colorants, lubricants, and the like. A preferred water insoluble non-cross-linked polymeric excipient capable of binding water is commercially available Avicel PH-200.

The active ingredient is processed in an oil or oily substance with preferably a melting point below 40 °C. Preferably the pharmaceutical composition comprises a dosage of 0.005 to 5 percent by weight of the active ingredient.

The active ingredient can be any active ingredient, and preferably a steroid. Preferred steroidal agents are selected from progestagen, estrogen, and mixtures thereof. With more preference the progestagens are selected from desogestrel, 3-ketodesogestrel, Org 30659 (17α-17-hydroxy-11-methylene-19-norpregna-4,15-dien-20-yn-3-one), levonorgestrel, and gestodene, whereas the estrogens are selected from ethinyl estradiol (EE), estradiol, and mestranol. Usually mixtures of progestagens and estrogens are used. Most preferred are tablets comprising desogestrel or ethinyl estradiol or mixtures thereof. Other suitable active ingredients are for example levothyronine, thyroxine, digitoxine and digoxine.

Oils for dissolving or suspending the progestagen and the estrogen can be of a natural, semi-synthetic or synthetic source. Fixed oils of vegetable origin consist mainly of (mixed) glycerides. Examples are arachis oil, castor oil, sesame oil, fractionized coconut oil (miglyols), ethyl oleate, maize oil, Gelucire (partial glycerides and polyglycide fatty acids), and the like. Other suitable liquids are liquid paraffin, dimethyl silicone fluid, triacetin, mono- and di-glycerides, and esters

of polyethyleneglycol, propyleneglycol, polyglycerol, glycerol, or glyceryl. The content of oil or oily substances will typically make up less than 7% by weight of the mixture for tabletting or capsulation, and preferably less than 4%, and more preferably from about 0.1 to 4%. The active compound can also be processed to mixtures of the oily substance and water. Emulsions are an example of such mixtures. If the oil content is 0% (thus no oil is present in the composition), preferably an aqueous solution or dispersion of the active ingredient is used. Known techniques and compositions for preparing suitable mixtures with the active compounds, oils, oily substances and optionally water are applicable. Emulsifying agents can be of the group of viscosity increasing agents like sugars, polyethylene glycols, gelatines, hydroxypropylcellulose (HPC), amylopectin, starch, carboxymethylcellulose (CMC), hydroxypropylmethylcellulose (HPMC), polyvinylpyrrolidone, gums like Arabic and Guar gum, cellulose based and starch based materials, and the like. Also emulsifying agents with ionogenic properties (sodium laurylsulfate, sodium dioctylsulfosuccinate, cetrimonium bromide) and non-ionogenic properties [monostearine (glycerol monostearate), monoleine, sorbitan esters (Spans), PEG-sorbitan ethers (Tweens, polysorbates), PEG-fatty acid esters (like the Polyoxyl 50 stearates), PEG-fat-alcohol ethers (Cetomacrogols) and the like] can be applied for stabilizing the emulsion.

The composition and concentrations of the components of the liquids (comprising the active compound) should be as such that agglomeration during mixing with the carrier-materials is avoided. For instance, agglomeration by addition of high concentrations of emulsifying agents of the group of viscosity increasing agents results in mixtures with unacceptable flow properties. For that reason any agglomeration should be avoided. The ratio between the amount of the water insoluble polymeric excipient capable of binding water and the amount of applied water should preferable be higher than 5 : 1, and more preferably higher than 10:1, in order to avoid impaired flow properties on the one hand and a drying step on the other hand. Materials to improve the flow characteristics are referred to as glidants. As an example, silicon dioxide, magnesium laurylsulfate or magnesium oxide can be added to the formulation to reduce interparticulate friction and to eliminate the problem associated with the flow of materials from larger to smaller apertures in the tablet presses. The composition comprising progestagen may further comprise colouring agents, disintegrants, lubricants, excipients to modify drug-release characteristics, and other additives.

The process for the preparation of the solid pharmaceutical composition of the invention is characterized in that a low dosage of an active ingredient is dissolved or dispersed in an oil or an oily substance, in an aqueous dispersion thereof, or in water, and thereafter mixed with a water insoluble non-cross-linked polymeric excipient capable of binding water and having a mean particle size greater than 150 µm, after which the solid composition can optionally be mixed with more of the water insoluble non-cross-linked polymeric excipient capable of binding water or with any other suitable pharmaceutically acceptable auxiliary, after which the solid composition obtained can optionally be compressed into tablets or filled into capsules.

The process of this invention excels by its simplicity and safety. The active substance is preferably suspended, dispersed, emulsified, or dissolved in the oil or oily substance, after which the liquid mass is mixed in a mixer with the water insoluble non-cross-linked polymeric excipient capable of binding water. Drying is not necessary. To improve the flow properties a glidand may optionally be added, for instance silicon oxide. Usually it is not necessary to add a lubricant, and the mixture can directly be used for tabletting or making capsules. Granulation to improve flow characteristics or to improve homogeneity by reducing segregation is not necessary.

The composition of this invention has various advantages over the known compositions, i.e. simplicity of the process not requiring granulation, agglomeration, drying or mixing with lubricants, and safety of the process not requiring organic solvents and possibility of performing the process in a closed system. The stability and the content uniformity of the active ingredient in the composition of the invention is good to excellent.

Tablets and capsules can be prepared according to generally known procedures, for instance as described in the reference work Gennaro et al., Remington's Pharmaceutical Sciences, (18th ed., Mack Publishing Company, 1990, see especially Part 8: Pharmaceutical Preparations and Their Manufacture).

The invention is further illustrated by the following examples:

Example 1

The active ingredients were processed to a homogeneous mixture (weight per tablet):

desogestrel	150 µg
Ethinyl estradiol (EE)	30 µg
Miglyol 812	1.3 mg
Water	3.68mg
Avicel PH-200	58.99mg
Methylcellulose MHB-50	0.07mg
Silicon dioxide	0.81mg

The active ingredients were suspended in Miglyol. Then the oil was mixed in a solution of methyl cellulose in water using an Ultra Turrax mixer for 5 min. The direct compression mixture was prepared by homogenizing the emulsion in a high shear mixer (Gral 10) with the microcrystalline cellulose Avicel PH-200. Admixing colloidal silicon dioxide was performed in a Turbula mixer during 10 minutes. Tablets weighing 65 mg were compressed on a Korsch PH 106 rotary press.

Example 2

Mixtures based on microcrystalline cellulose with desogestrel and EE were prepared as described in example 1 applying emulsions with the following compositions (weight per tablet):

	Composition applied emulsion (per tablet) in mg										
	1	2	3	4	5	6	7	8	9	10	11
Miglyol 812	1.30	1.30	-	-	-	-	-	-	-	1.30	-
Arachis oil	-	-	1.30	1.30	1.30	-	-	-	-	-	1.30
Sesame oil	-	-	-	-	-	1.30	1.30	1.30	1.30	-	-
CMC-sodium	0.04	-	0.04	-	-	0.04	-	-	-	-	-
Methylcell. MHB-50	-	-	-	0.07	-	-	0.07	-	-	-	-
Span 80	-	0.13	-	-	0.13	-	-	0.13	-	-	-
Tween 80	-	0.13	-	-	0.13	-	-	0.13	-	-	-
Arabic gum	-	-	-	-	-	-	-	-	0.2	0.2	0.2
Water	3.66	3.46	3.68	3.66	3.46	3.68	3.66	3.46	3.53	3.53	3.53

After admixing with colloidal silicon dioxide the mixture is compressed to tablets.

Example 3

The active ingredient was processed to a homogeneous mixture comprising (per tablet):

Org OD-14	0.3 mg
Miglyol 812	1.3 mg
Avicel PH-200	63.4 mg

The active compound Org OD-14 [(7α,17α)-17-hydroxy-7-methyl-19-nor-17-pregn-5(10)-en-20-yn-3-one] was mixed with the oil. Then the oil was homogenized in the mass of microcrystalline cellulose using a Gral 10 High shear mixer. The final mixture was compressed to tablets with a weight of 65 mg.

Example 4

Tablets were prepared according the process described in Example 1 and with the following composition:

Org 30659	60 µg
EE	20 µg
Miglyol 812	1.3 mg
Methylcell MHB-50	0.02 mg
Water	1.20 mg
Avicel PH-200	61.75 mg
Silicon dioxide	0,65 mg

Example 5

The active ingredients were processed to a homogeneous mixture (weight per tablet):

desogestrel	150 µg
Ethinyl estradiol (EE)	30 µg
Hydroxypropyl cellulose (HPC)	150 µg
Water	4.95mg
Primojel	2.65mg
Avicel PH-200	57.06mg

HPC was dissolved in the water to a 3% HPC-solution. The active ingredients were suspended in this solution using an Ultra Turrax mixer for 5 min. The direct compression mixture was prepared by homogenizing the desogestrel/EE suspension in a high shear mixer (Gral 10) with the microcrystalline cellulose Avicel PH-200 and Primojel. Tablets weighing 65 mg were compressed on a Korsch PH 106 rotary press.

Example 6

The active ingredients were processed to a homogeneous mixture (weight per tablet):

desogestrel	150 µg
Ethinyl estradiol (EE)	30 µg
Hydroxypropyl cellulose (HPC)	150 µg
Gelucire 35/10	2.44mg
Water	2.44mg
Sodium Laurylsulfate (SLS)	0.32mg
Avicel PH-200	58.67mg
Silicon dioxide	0.81mg

The Gelucire was heated at 50 °C, after which the active ingredients were suspended. The mixture was mixed in a solution of HPC in water using an Ultra Turrax mixer for 5 min. The direct compression mixture was prepared by homogenizing the desogestrel/EE emulsion in a high shear mixer (Gral 10) with the microcrystalline cellulose Avicel PH-200 and SLS. Admixing colloidal silicon dioxide was performed in an Erweka mixer for 1 min. Tablets weighing 65 mg were compressed on a Korsch PH 106 rotary press.

Example 7

Tablets were prepared according to the composition and the procedure as described in Example 1. The two batches of tablets comprised 150 µg of desogestrel (uncoated tablets) and 60 µg of Org 30659 (coated tablets) respectively. The tablets were subjected to accelerated storage conditions. The stability results are depicted in the Table (RH=relative humidity).

	desogestrel(%) after 3 months of storage	Org 30659(%) after 1 month of storage
40°C/50%RH	-	97.8
40°C/ambient	98.9	-
40°C/75%RH	100.0	97.3
50°C/75%RH	100.4	-

The results indicate a good stability of both progestagens in tablets in accelerated storage conditions.

Example 8

A composition comprising a water insoluble non-cross-linked polymeric excipient capable of binding water according to this invention (Avicel PH-200) was compared with a composition comprising a water insoluble non-cross-linked polymeric excipient capable of binding water having a mean particle size smaller than 150 µm (Avicel PH-102) and with a composition comprising a water insoluble cross-linked polymeric excipient capable of binding water according to EP

598,337 (crospovidone), each composition being with or without oil (miglyol):

Compositions (amounts in g):					
composition	miglyol 812	HPC*	water	Avicel PH-200	total mass
A	0	0.5	15.5	183.8	200
B	4.0	0.4	11.6	183.8	200
composition	miglyol 812	HPC*	water	Avicel PH-102	total mass
C	0	0.5	15.5	183.8	200
D	4.0	0.4	11.6	183.8	200
composition	miglyol 812	HPC*	water	Polyplasdone XL 10#	total mass
E	0	0.2	7.8	92.0	100
F	2.0	0.2	5.8	92.0	100

* Hydroxy propyl cellulose
# crospovidone

The flowability was determined by measuring the amount of composition in g per sec passing through a funnel, having a diameter of 9.0 mm. The compositions B, D, and F are an 8% emulsion (2% miglyol), the compositions A, C, and E are an 8% HPC solution:

composition	flowability in g/s
A	2.97
B	1.49
C	0
D	0
E	0
F	0

Claims

1. A solid pharmaceutical composition comprising less than 7% by weight of an oil or oily substance, a low dosage active ingredient, and a water insoluble non-cross-linked polymeric excipient capable of binding water and having a mean particle size greater than 150 µm.

2. The solid pharmaceutical composition of claim 1, comprising less than 4% by weight of an oil or oily substance.

3. The solid pharmaceutical composition of claim 1 or 2, wherein the oil or oily substance has a melting point below about 40 °C.

4. The solid pharmaceutical composition of any one of claims 1-3, wherein the active ingredient comprises a dosage of 0.005 to 5 percent by weight.

5. The solid pharmaceutical composition of any one of claims 1-4, wherein the active ingredient is a steroid.

6. The solid pharmaceutical composition of any one of claims 1-5, wherein the water insoluble non-cross-linked polymeric excipient capable of binding water has a mean particle size of at least 180 µm.

7. The solid pharmaceutical composition of any one of claims 1-6, wherein the water insoluble non-cross-linked polymeric excipient capable of binding water is a cellulose or a starch.

8. The solid pharmaceutical composition of any one of claims 1-7, wherein the active ingredient is desogestrel, ethinyl estradiol, or a mixture thereof.

9. A process for the preparation of the solid pharmaceutical composition of any one of claims 1-8, characterized in that a low dosage of an active ingredient is dissolved or dispersed in an oil or an oily substance, an aqueous dispersion thereof, or in water, and thereafter mixed with a water insoluble non-cross-linked polymeric excipient capable of binding water and having a mean particle size greater than 150 µm, after which the solid composition can optionally be mixed with more of the water insoluble non-cross-linked polymeric excipient capable of binding water, or optionally with other pharmaceutically acceptable auxiliaries, after which the solid composition obtained can optionally be compressed into tablets or filled into capsules.

10. The process according to claim 9 wherein the ratio of the water insoluble non-cross-linked polymeric excipient capable of binding water and water as present in the process is chosen greater than 5:1, and preferably greater than 10:1.

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 20 2770

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
P,X	WO-A-94 23700 (RIJKSUNIVERSITEIT GENT LABORATORIUM VOOR PHARMACEUTISCHE TECHNOLOGIE) * claims 1,2,5,6,12 * * page 3, line 1 - line 10 * * page 4, line 35 - page 5, line 9 *	1-10	A61K9/20 A61K31/565
P,Y	WO-A-95 06461 (SMITHKLINE BEECHAM CORPORATION) * claims 7-11 * * examples 1,2 *	1-7,9,10	
Y	EP-A-0 598 337 (VECTORPHARMA INTERNATIONAL) * claims 1-3,5,6,10 * * column 2, line 2 - line 28 * * page 3, line 7 - page 4, line 52 *	1-7,9,10	
			TECHNICAL FIELDS SEARCHED (Int.Cl.6) A61K

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	9 January 1996	Ventura Amat, A

CATEGORY OF CITED DOCUMENTS

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